TECHNICAL NOTES

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Enhancements for Native Bees in Western Oregon and Washington Cranberry Production

Kathy Pendergrass, Plant Materials Specialist, NRCS, Portland, Oregon
Mace Vaughan, Xerces Society, Portland, Oregon

A native bee (Melitta_americana) foraging on cranberry (Vaccinium macrocarpon).
(Photograph by Michael Veit http://www.discoverlife.org/mp/20p?see=I_VEIT1&res=640)

The purpose of this technical note is to provide information about improving native pollinator services for cranberry production in western Oregon and western Washington.

We welcome your comments for improving any of the content of this publication for future editions. Please contact kathy.pendergrass@or.usda.gov

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Brief Introduction to the Issue:

This publication is intended to provide recommendations for cranberry pollination enhancement for western Oregon and western Washington. The Natural Resources Conservation Service (NRCS) can sometimes provide cost share for growers interested in establishing pollinator habitat on their farms. Visit staff at your local NRCS office for details of programs that can support this.

Within Oregon and Washington, cranberries are produced in beds along both southwest coasts – between Grays Harbor and Willapa Bay in Washington, and just north of Bandon to Port Orford in Oregon (Figure 1.). Both locales have a cool, cloudy and windy environment that impedes the amount of time that honey bees will forage. Both areas are within the Coast Range EPA Level III Ecoregion (https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-continental-united-states) and have fairly similar climatic regimes and dominant vegetation types.

Figure 1. Cranberry production areas in southwestern Oregon and southwestern Washington as indicated by the cranberry clusters.

Pollination is required for cranberry production: Cranberries require high levels of pollination to form large, high-quality berries and to maximize yields. Honey bee hives are transported to cranberry beds during peak bloom to ensure there is adequate crop pollination. However, honey bees have a difficult time accessing the pollen in cranberry flowers. They have to "drum" cranberry flower anthers with their forelegs to shake out pollen to bring back to the hive, or forage solely for nectar and move pollen accidentally (Cane et al. 1993). Cranberries are more efficiently pollinated by buzz-pollination, a process where bees vibrate their wing muscles to shake pollen loose from flowers (De Luca and Vallejo-Marín 2013). Bumble bees and many other native bee species can perform buzz-pollination, whereas honey bees cannot. As a result, bumble bees (and other buzz-pollinating bees) are more efficient pollinators than honey bees on an individual basis. This is not to say that honey bees do not pollinate cranberry effectively. Studies have shown that providing abundant honey bees to a cranberry bed increases overall pollination and subsequent production of cranberries (Evans and Spivak 2006). The

safest strategy to ensure adequate cranberry pollination is to import honey bee hives to cranberry beds while also enhancing or protecting habitat for native bees.

Honey bees are generally readily available to rent for cranberry pollination. In the early 2000's, honey bees were rented at approximately $30 to $35 per hive. The current cost of renting a honey bee hive in SW Oregon for cranberry pollination service is approximately $85 per hive (personal communication, Bob Nelson, Cranberry Grower in SW Oregon). Western Washington cranberry producers pay approximately $60 to 75 per hive, depending on beekeeper and year (pers. comm., Kim Patten, Washington State University Extension Service). One to two hives per acre are generally recommended to pollinate a cranberry bed (Pacific Northwest Extension Service Publication 623. 2011), although this is dependent on size, variety and condition of the bed, and on the condition of rental hives. With ongoing high annual hive losses amongst beekeepers, and the subsequent increased cost to rent hives for pollination, there is a need to enhance alternate pollinators for cranberries (Loose et. al 2005), and to create landscapes that better sustain local bee populations.

There are some 4,000 species of native bees in the United States (http://bugguide.net/node/view/475348). Most of these species are generalists and will forage for nectar and pollen on a wide range of plant species, including crop flowers. Some 182 wild native bee species have been identified around Wisconsin cranberry beds (McFarlane 1995). Loose et al. (2005) found some 80 species of native bees associated with cranberry in Maine. A study by Broussard et al. (2011) found 27 native bee species present during and just after bloom in cranberry beds along the southern Oregon coast. Honeybees (68.1%) and three species of bumble bees (31.6 %) comprised 99.7% of foragers. Honey bees were observed collecting nectar but no pollen more often than bumbles bees, and bumble bee pollen loads had greater mass than those of honeybees, indicating the important pollination services that bumblebees are contributing to cranberry pollination.

It is possible that pollination of cranberry beds surrounded by "wild" habitats could rely solely on wild bees. Macfarlane (1995) noted that Wisconsin beds less than five acres in size with surrounding woodland, had high resident bumblebee populations and did not need honey bees. Wild bees have been shown to be important pollinators of cranberries beds in British Columbia (Ratti 2006), Massachusetts, Maine (Loose et. al 2005), and Oregon (Broussard et. al 2011). In a Wisconsin study, more habitat within 1 km (0.62 miles) of cranberry beds resulted in more wild native bees present (Macfarlane 1995).

In general, bumble bees are proven to be stronger flyers and will fly at cooler temperatures than honey bees (MacKenzie 1994). This has also been determined for bees along the southern Oregon coast (Broussard et. al 2011). Flying when temperatures are cooler and winds are higher are certainly important traits for a pollinator in cool and windy environments such as the coastal areas of Oregon and Washington, where cranberries are grown.

Bumble Bee Life History and the Need for Season-Long Nectar and Pollen Food Resources:

The most important native bees for cranberry pollination in Oregon and Washington are bumble bees. Their colonies are typically active for an entire growing season, producing many generations of workers (http://www.bumblebee.org/lifecycle.htm). These bees require season-long blooms to sustain the colony. Queen bumble bees emerge in early spring from their overwintered nests in the ground. They actively collect nectar and pollen to establish a new colony during March and April (Macfarlane and Patten 1997). Nectar provides water and sugar for the bee diet, while pollen provides protein and essential vitamins and minerals. The queen bee especially needs large quantities of pollen to provision egg cells until enough worker bees are produced to maintain the hive. A continuous supply of pollen is required for brood rearing or the queen may cease to lay eggs and the larvae may die in their cells (Lovell 1926). It is critical that queen bees have access to plants that provide heavy loads of pollen to develop strong hives each spring.

Once enough worker bees have hatched and matured, the queen bee can safely remain in the nest chamber and be tended by worker bees. Season-long sources of nectar and pollen are necessary to support the hive until new queens are produced, mate and fly off in the fall to establish new nests to hibernate through the winter. These queens are the only bees to survive into the next year, as the rest of the colony dies in the fall at the onset of cold weather. Providing good continuous bloom near beds can ensure strong hives through the growing season and healthy queens to return year after year.

Macfarlane and Patten (1997) examined the relative attractiveness of perennial floral resources to bumble bees around cranberry beds in the Pacific Northwest (most time was spent at Long Beach Peninsula, WA, followed by Bandon, OR and Richmond, B.C.) throughout the summer. They found a shortage of bumble bee forage resources early and late in the season and suggested that planting for early and late-blooming wild flowering plants may boost bumble bee abundance. In the early spring, emerging queens establishing new colonies require food resources close to the nest, and in late summer large colonies have high food requirements.

Contrary to the findings of Macfarlane and Patten (1997), early blooming pollinator plants may be abundant in native habitats along many sections of the Pacific Coast. During an April 5, 2016 visit to numerous cranberry beds along the SW coast of Oregon, it was observed that much of the area is still in a relatively natural state with an abundance of native flowering trees (including willows), shrubs and herbaceous plants - except in those areas heavily invaded by gorse or consisting of pasture. It is thought that many of the native flowering plants produce abundant nectar and pollen including kinnikinnick, salal, madrone, evergreen huckleberry, salmonberry, big leaf maple, vine maple, cascara, dwarf Oregon grape, and others. Most of these plants in the surrounding habitats flower before peak cranberry flowering, thus the surrounding blooming habitats should help establish good populations of bumble bees ahead of the cranberry bloom.

Cranberries generally bloom from mid-May, peak in mid-June, and some blooms continue into mid-July – timing depends on local weather conditions and vine nutrition. There is generally a lack of blooming plants in native habitats after the cranberry bloom period (late June onward). **Planting additional late blooming plants around beds** would especially help support strong bumble bee populations until new queens hatch and disperse in the fall, thus enhancing the following year's bumble bee population.

Assess/Protecting Existing Habitat in and Around Cranberry Beds

An on-farm assessment should first be made of existing nesting and foraging resources and management impacts (particularly insecticide use) on pollinators. Please refer to the Xerces Society "Habitat Assessment Form and Guide for Farms and Agricultural Landscapes" at: http://www.xerces.org/pollinator-conservation/habitat-assessment-guides/. This guide will help you determine the amount and quality of the existing habitat around your cranberry beds.

Assessing native bee nesting habitat. Approximately 70% of all native bees, including bumble bees, are ground-nesters, while about 30% of bees nest in wood (dead pithy stems or beetle holes in decaying wood). It is important that nesting habitat be abundant near cranberry beds.

> **Assessing bumble bee nesting habitat:** Unlike the narrow tunnels used by most solitary bees, bumble bees need small cavities the size of a softball or bigger in which to nest. Frequently, these are old rodent burrows, and they may be underground, under lodged grass, under piles of stone or brush, or in other places where rodents may nest. For some bumble bees, these sites may also be found along overgrown forest edges or other areas where vegetation is left undisturbed long enough to form dense litter under which rodents may have nested. In other cases, bumble bees may create their nests in cavities left by voles or other rodents which may be in the middle of mown lawns or hay fields.

Overwintering sites for bumble bee queens. In addition to nesting sites, bumble bees need locations for queens to overwinter. These sites are frequently in the humus layer of leaf litter or conifer needles in forests, or in other soft soils in which bumble bee queens can dig in the late fall to find a relatively dry and insulated place to weather winter rain and snow.

Nesting habitat questions to answer for each cranberry bed operation include:

- Is there an ample amount of undisturbed bare or sparsely-vegetated ground near (particularly within 600 ft.) cranberry beds for bumble bees and other ground-nesting bees to make their nests?
- Are there ample amounts of downed logs and limbs, snags and dead tree limbs in the vicinity (particularly within 600 ft.) of cranberry beds for wood-nesting bees to build nests? (This is primarily for solitary-nesting bees.)
- Are potential nesting areas in warm and sunny locations? Exposed warm, well-drained south slopes have proven to be popular locations for nesting bees.
- Are there any signs that bees are using these areas for nesting?
- Are there forest edge habitats or other areas with dense grasses, shrubs and wildflowers allowed to become overgrown to provide potential nesting sites for bumble bees?
- Are there forest edge habitats or other areas with thick humus or litter layers, and that are elevated so as to avoid becoming waterlogged (i.e. relatively dry).

Assessing foraging resources in and around cranberry beds. Woodlands and other native habitats in western Oregon and Washington generally contain good nectar and pollen plants in the canopy and understory, such as: maple, madrone, cascara, kinnikinnick, salal, evergreen huckleberry, and oceanspray, (see species list and bloom timing in Tables 1 and 2). Especially determine if there is an abundance of early and late-blooming plants within 600 feet of cranberry beds and whether these plants are receiving adequate light for good flower production. Take clues from what you observe. Consider adding more bee-preferred plants or plants that bloom during gaps in bloom of your existing adjacent vegetation.

Foraging habitat questions to answer for each cranberry bed operation include:

- Do you have a diversity of plants blooming throughout the season, especially before and after cranberry bloom, in areas adjacent to cranberry beds?
- Do you see bees present on adjacent blooming plants?
- What plants are bees, especially bumble bees, using in the areas around cranberry beds?
- Are there available areas where high-value pollinator plants could be planted near your cranberry beds?

Pest Management and Bee Protection

Cranberries generally have few pests. Primary insect pests include black-headed fireworm (*Rhopobota naevana*), cranberry girdler (*Chrysoteuchia topiaria*), and black vine weevil (*Otiorynchus sulcatus*) (Strik 2002). Recently, there has been an outbreak of a hard scale occurring on the southwest Oregon coast that will require the use of insecticides to contain insect spread and damage (personal communication Bob Nelson, SW Oregon cranberry grower). There is a narrow timeframe for needed pesticide applications – after plant growth has started in the spring and before bloom timing. Soaps can reduce soft scale outbreaks, but stronger chemicals, that are generally toxic to bees, are needed to control hard scale.

Damage to bee populations can be reduced by applying pesticides at night, using chemicals with the shortest possible residual toxicity, using least toxic active ingredients (e.g. insecticides that target Lepidoptera), and liquid formulations (rather than dusts). Also, providing or protecting flowering plants around beds can help increase populations of predatory and parasitic wasps that assist with biocontrol of pests (Loose et. al 2005). **Wild flowering plants and planted foraging habitats should be protected from pesticide drift.**

General guidelines when using pesticides: 1) Minimize their use and follow Integrated Pest Management practices, 2) Don't spray when cranberries are blooming, if possible, 3) Use least toxic alternatives, 4) apply pesticide two hours after sunset, 5) Protect adjacent habitat from drift, and 6) Follow guidance and labels carefully.

Please refer to Oregon State University Extension Publication # 591 (Hooven et. al 2016), "How to Reduce Bee Poisoning from Pesticides", for further information.
https://catalog.extension.oregonstate.edu/pnw591

Strategies to Improve Pollinator Habitat Components:

To encourage native pollinators into cranberry beds to assist in pollination, all habitat components including nests sites and bloom for nectar and pollen need to be situated close to the beds. Rao and Strange (2012) found that bumble bees would range as far as 7.2 miles to blooming clover fields – a concentrated forage resource. However, flight range for many small bee species like mining and sweat bees is typically around 200 meters (600 ft.) (Loose et. al 2005). Macfarlane and Patten (1997) found that small, growing bumble bee colonies would often fail if early food sources were further than 100 meters (~300 ft.) from nests. The further bees must fly to find nectar and pollen, the fewer offspring will be produced and the less chance that bees will fly far distances to forage resources and return to nest near cranberry beds (MacKenzie 2009). The best strategy is to provide early season forage resources and nesting habitats as close to cranberry beds as possible.

Provide additional nesting habitat for bees. Undisturbed bare soil areas located on south-facing warm slopes are important nesting habitat for bumble bees and other ground-nesting solitary bees. Look for nests on relatively dry south facing slopes, paying close attention during cranberry bloom, to see if you have areas of ground nests that may be protected.

Also, allow for a "messier" landscape adjacent to beds. For example, leave dead limbs on trees and shrubs and leave old downed trees, stumps and limbs to rot and be available for nesting sites. Nesting habitat can also be augmented by adding wood bee blocks and/or bundles of bamboo or shrub stems such as elderberries. The pith of dead stems of elderberries provides especially good nesting cavities for solitary bees, such as small carpenter bees, that may visit cranberry.

These same overgrown areas may provide cover and litter used by bumble bee queens for nesting or overwintering. It is recommended to leave some areas undisturbed and only mown once every two or three years, at eight inches or higher, and leave clippings to decompose on-site. Be sure to manage invasive or weedy plant species.

These messier areas can be separated from beds by closely mown strips and roads to help minimize weed encroachment and to create exposed areas in which rodents would hesitate crossing.

Refer to "Enhancing Nest Sites for Native Bee Crop Pollinators" for further information:
https://www.plants.usda.gov/pollinators/Enhancing_Nest_Sites_For_Native_Bee_Crop_Pollinators.pdf

Allow nearby herbaceous areas to bloom prior to and after cranberry bloom. Most wildflowers (even weeds) provide nectar and pollen resources for bees. Areas could be left un-mowed ahead of and after cranberry bloom to provide additional resources for wild bee forage.

If beds are within a forested landscape, consider thinning margins of forested habitats adjacent to cranberry beds. There is often an abundance of native flowering trees, shrubs and wildflowers along the edges of forested habitats in western Oregon and Washington. Thinning conifers along forest edges can allow the blooming trees, shrubs and herbaceous plants already present to increase in size and extent in the understory. Plants with more access to sunlight tend to produce more prolific bloom along these edges and in canopy openings. Consider leaving piles of the woody debris from thinning to decay and become nesting habitat for bees. Plants to mark and protect from thinning include willows, maples, salmon berry, cascara, madrone, salal, Oregon grape, rhododendron, elderberry, and evergreen huckleberries.

Enhance nearby bee foraging areas by planting pollinator plants for continuous bloom. This is the most important habitat element to support native bee populations, particularly bumble bees, which forage all season. Bumble bees cannot store food for more than a couple of days, thus abundant blooming sources should be located next to beds and nest sites. We know that floral resources around crop peripheries are important to pollinators (Loose et. al 2005). And bees likely benefit from a diversity of floral resources (different species with various flower colors, shapes and chemistries) which may correspond to balancing various nutritional needs supplied by the different nectars and pollens of various plant species (Decourtye et al. 2010, Hendriksma and Shafir 2016). Bumble bees have been found to forage to maximize floral species richness over floral density (Jha and Kremen 2013), thus, a good strategy would be to provide a diversity of blooming plants near beds. As a general rule, it is advisable to **provide at least three different plant species blooming in each spring, summer and fall seasons,** for a minimum of nine flowering plant species through the seasons. For cranberry beds, emphasize species that bloom in the spring, late-summer, and fall. Augmentation with pollinator plants will especially benefit beds that are surrounded by poor pollinator habitat, such as grass-dominated pastures or monoculture croplands.

Growers might consider planting pollinator hedgerows near cranberry beds (Figure 2). Hedgerows consist of trees, shrubs and/or tall (4+ ft.) herbaceous plants planted in rows. Preferably hedgerows would include clumps of herbaceous plants, especially late-blooming, large-statured wildflowers. Hedgerow areas can be mulched and weeds relatively easily managed. Pollinator shrubs and trees could alternatively or also be planted into any available areas in and around beds in a design that works best for each situation.

Clustered plantings (greater than 3x3 foot) of flowers are more attractive and easier for bees to find than scattered plants. Consider planting separate large blocks or strips of early and late blooming plants in separate "Bloom Islands" (Figure 2.). A block of similarly blooming plants can be more compatibly managed. Benefits of this approach include:

- Plants concentrated into resource islands are easier to care for and manage than when spread over larger areas. For example, a planted block with similar bloom timing could be mowed at the end of bloom and prior to extensive dispersal of seeds into cranberry beds – making it easier to control invasions into beds.
- Grasses around islands can be mowed to control weeds.
- Island plantings of wildflowers (broadleaf plants) and are separate providing more herbicide options.
- Mulch can be applied in these island plantings to aid in moisture retention for establishing plants and to help control weed competition.

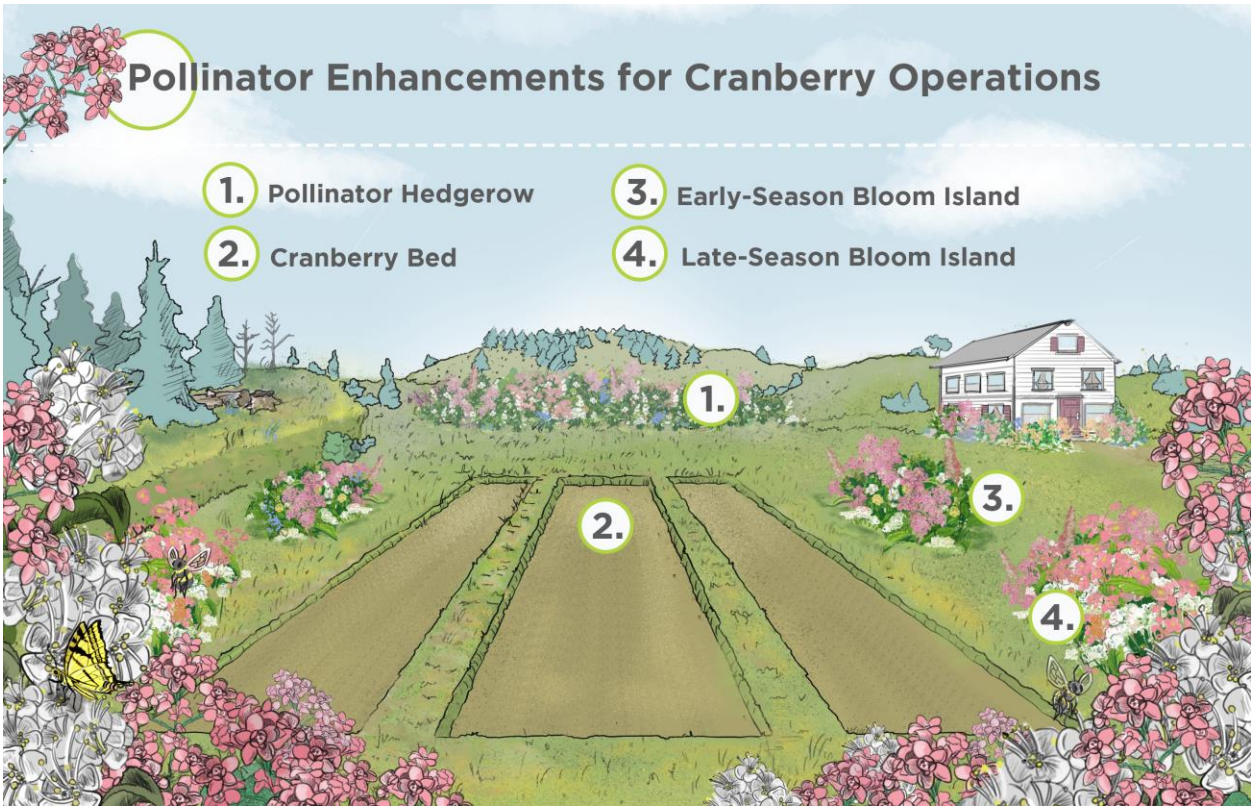

Figure 2. *Enhancements that could be added to improve pollinator habitat near cranberry beds, including: hedgerows, early-season and late-season pollinator "bloom islands".*

Refer to Tables 1 and 2 at the end of this document for information on bloom timing and plant attributes to help in planning plantings to augment pollinator forage.

Care should be taken to establish pollinator plants outside of the rooting zone where fertigation activities occur and where wild pollinators could be killed if systemic insecticides are delivered through fertigation (personal communication from Kim Patten, Washington State University Extension Service).

Especially augment early-season bloom – There is conflicting information on the importance of willows (*Salix* spp.) in providing good early nectar and pollen resources (Macfarlane and Patten 1997, Mackenzie 2009; Lovell 1926). A majority of studies reviewed indicated willows to be very important plants for both pollen and nectar resources. Willows are dioecious, with males (pollen-bearing) and females (seed-bearing) on separate trees/shrubs. Male plants supply the needed early protein-rich pollen for bee colony establishment and growth. Female flowers produce nectar that can exceed 50% sugar content, which is also an important resource (Burgett et. al 1989). But female plants produce seeds which can establish prolifically in cranberry beds, and can compete with the cranberry plants. Since willow species can be problematic invaders of cranberry beds, plantings of willows might be accomplished in adjacent riparian areas but within bee flight distance to cranberry beds (within 5-7 miles; better would be within ¼ mile). Another strategy might be to plant **male-only willow plants** (i.e. by collecting stakes/cuttings from only identified male plants) around cranberry beds, while removing any female trees from the immediate vicinity of beds. Other early blooming plants could be planted in hedgerows or into any available areas or in bloom islands near beds.

Especially augment late-season bloom – Generally, little bloom is available in surrounding native habitats after cranberries have finished blooming. Providing this late bloom will allow honey bee hives to remain strong and help bumble bee colonies to produce large numbers of new queens. These new queens will establish an overwintering nest in the nearby landscape as they go into hibernation for the winter. The queens will emerge the following spring to build new colonies near cranberry beds if good habitats are available. Woodward (1990) found that the greatest total need for food by bumblebee colonies occurred 10 days before new queens are produced, thus late floral resources are very important to maintaining strong bumble bee hives.

Refer to the plant choices in Tables 1 and 2. Good late-season pollinator plants include: fireweed, California aster, seaside daisy, and goldenrod. If these plant species are considered weedy to cranberry beds, providing a late-season refuge of nectar/pollen (late-season bloom islands) resources within 1/8 to ¼ mile would help maintain wild bees (especially bumble bees, which can travel long distances) in proximity to the beds while reducing possible movement of seed from these species into the beds.

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Further Information

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Native Plants for Willamette Valley Yards by Metro in partnership with NRCS and others.
http://www.oregonmetro.gov/sites/default/files/native_plants_for_willamette_valley_yards_booklet.pdf

Native Plants Frequented by Native Bees and Other Pollinators, Southern Willamette Valley, Oregon
http://extension.oregonstate.edu/lane/sites/default/files/documents/nativepollinatorplants.pdf

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https://catalog.extension.oregonstate.edu/ec1577

Plants for Pollinators. A Regional Guide for Farmers, Land Managers, and Gardeners in the Pacific Lowland – Mix Forest Province. Including the states of Oregon and. Washington. The Pollinator Partnership: http://www.pollinator.org/PDFs/PacificLowlandrx8.pdf

Hansen's Northwest Native Plants Database:
http://www.nwplants.com/information/wildlife_habitat.html

Where to Find Plants

Oregon Flora Website – Gardening with Native Plants Portal: shows nurseries that carry individual plant species http://www.oregonflora.org/gardening.php

Technical Note 41: Cover Crop Resources and Seed Vendors for Oregon and Washington (PDF; 464 KB) Young-Mathews, A., and P. Pavek 2014. USDA NRCS Corvallis Plant Materials Center and Pullman Plant Materials Center. Portland, OR and Spokane, WA. 2014. 10p. (ID# 12333).

Table 1. Selected Plants for Pollinators. Some trees and most shrubs on this list can be maintained as a hedge or cut back to 3 feet tall (or shorter, during the dormant season). For trees and shrubs, the NRCS practices "Hedgerow" (422), "Tree and Shrub Site Preparation" (490), and/or "Tree and Shrub Establishment" (612), can be used to establish plants. For herbaceous plants, the NRCS Conservation Cover (327) and Field Border Practices (386) can be used to plant or seed new plants onto a site. *Many good native pollinator plants may already be present in the adjacent landscape. Information is provided for these plants so that growers can appropriately manage for these plants. It is unknown whether some of these species might spread into cranberry beds - plantings should be monitored and managed accordingly. Best planting stock is generally container plants. Best time to plant is with the fall rains. All plants will need supplemental summer watering for 2-3 years to establish; non-native plants may require supplemental summer water indefinitely. Plant survival and bloom might be enhanced with some supplemental watering during summer drought. Plants do well with full sun to partial shade, unless otherwise indicated in notes.

COMMON NAME	SCIENTIFIC NAME	N = native; I = Introduced	Flower Color	Growth Form	Mature Height (feet)	Planting distance Apart (feet)	Water Needs	Wind-blown Seed - or potential to invade beds	NOTES
Early Season Blooming Species									
Big leaf Maple	*Acer macrophyllum*	N*	Yellow	Tree	80	15-25	Medium	Yes	Of great importance to spring build-up of bee populations. Trees are susceptible to verticillium wilt
Hairy manzanita	*Arctostaphylos columbiana*	N*	Pink	Shrub	10	5-10	Low	No	Evergreen. Potentially of high value to early spring buildup of pollinator populations - sugars 35-65%. Plants need good drainage
Kinnikinnick	*Arctostaphylos uva-ursi*	N*	Pink	Shrub	1.5	2-4	Low	No	Evergreen. Prefers well-drained soils. Very tough plant
Rock cress	*Arabis spp.*		White	Herbaceous	1	2-3	Low	No	Rock garden plant with low maintenance needs. Best to shear after blooming to keep plant invigorated
Aubretia	*Aubretia spp.*		Purples	Herbaceous	1	3	Low	No	Rock garden plant with low maintenance needs. Best to shear after blooming to keep plant invigorated
Wallflower	*Erysimum spp.*		yellows to oranges	Herbaceous	2	3	Low	No	Rock garden plant with low maintenance needs. Best to shear after blooming to keep plant invigorated
Tall Oregon Grape	*Berberis aquifolium*	N	Yellow	Shrub	8	3-5	Low	No	Evergreen. Abundant nectar and pollen - sugars 40-54%
Dwarf/Cascade Oregon Grape	*Berberis nervosa*	N*	Yellow	Shrub	2	3	Medium	No	Evergreen. Does well with part to full shade.
Winter Blooming Heaths (early season varieties recommended by Strik 2002)	*Erica x darleyensis ('Alba','Darley Dale', 'Furzey'); Erica carnea ('Springwood Pink' and 'Springwood White')*	I	White to deep pinks	Shrub	1	3-5	Low	No	Evergreen. Many varieties; blooming November-April. Very attractive to honey bees. Generally need good drainage. Should shear/cut back lightly after flowering to maintain good shape and bloom.
Red Currant	*Ribes sanguineum*	N	Pinks to Reds	Shrub	10	5-10	Medium	No	Important plant for hummingbirds.

COMMON NAME	SCIENTIFIC NAME	N = native; I = Introduced	Flower Color	Growth Form	Mature Height (feet)	Planting distance Apart (feet)	Water Needs	Wind-blown Seed - or potential to invade beds	NOTES
Salmonberry	*Rubus spectabilis*	N*	Magenta	Shrub	12	3-5	High	No	Flowers attract migrating hummingbirds. Suckering will expand plant over time. Fair establishment from hardwood cuttings (live stakes).
Pacific Willow	*Salix lasiandra var. lasiandra*	N*	Yellow-green	Tree	30	10-20	High	Yes	Likes wet locations. Is a tree-form willow, rather than a bush-type. Nectar sugars can exceed 50%. Dioecious plants. Male plants provide critical early pollen (protein) resource. Can be maintained as a tree or shrub based on pruning. Establishes well from cuttings.
Scouler's Willow	*Salix scouleriana*	N*	Yellow-green	Tree - multi-stem form	10-20+	10-20	Medium	Yes	Can occur/be happy in uplands. Has a bush/multi-stemmed growth. Nectar sugars can exceed 50%. Dioecious plants. Male plants provide critical early pollen (protein) resource. Can be pruned heavily to reduce size. Establishes well from cuttings.
Hooker's Willow	*Salix hookeriana.*	N*	Green	Tree-multi-stem form	10-20+	10-20	High	Yes	Likes wet locations. Nectar sugars can exceed 50%. Dioecious plants. Male plants provide critical early pollen (protein) resource. Can be pruned heavily to reduce size. Establishes well from cuttings.
Early to Mid-Season Blooming Species									
Vine Maple	*Acer circinatum*	N*	Yellow	Tree	20	10-20	Low	No	Abundant nectar and pollen - sugars 27-58%. Will grow well in shade or sun
Saskatoon Serviceberry	*Amelanchier alnifolia*	N	White	Tree	15-20	10-20	Medium	No	Bees use the pollen. Fleshy blue-black edible berry in summer/fall
Madrone	*Arbutus menziesii*	N*	Cream	Tree	80	15-25	Low	No	Evergreen. Can be important nectar resource (sugars 10-20%). Needs good drainage
Golden chinkapin	*Castanopsis chrysophylla*	N*	Cream	Shrub-tree	15	7-15	Medium		Early pollen and nectar for colony growth. Attractive to honey bees. Not present in Washington.
Blue blossom	*Ceanothus thyrsiflorus*	N/I	blue	Shrub	10	7-15	Low	No	Evergreen. Good nectar and pollen source. Native to SW Oregon.
California Poppy	*Eschscholzia californica*	N	Yellows and oranges	Herbaceous	1	NA	Low	No	Annual, reseeds itself. Long blooming - spring to fall.
Cascara	*Frangula (Rhamnus) purshiana*	N*	Green	Tree	35	10-20	Medium	No	Can be maintained as shrub based on pruning. Blooms up to six weeks. High nectar value to bees.
Oregon Crabapple	*Malus fusca*	N	White	Tree	15	7-15	Medium	No	Performs best with higher soil moisture.
Black Twinberry	*Lonicera involucrata*	N*	Yellow	Shrub	10	7-15	Medium	No	Attractant for hummingbirds. Heavy nectar production.
Bitter cherry	*Prunus emarginata*	N	White	Tree	20	7-15	Medium	No	Sugar content 40-50%.

COMMON NAME	SCIENTIFIC NAME	N = native; I = Introduced	Flower Color	Growth Form	Mature Height (feet)	Planting distance Apart (feet)	Water Needs	Wind-blown Seed - or potential to invade beds	NOTES
Chokecherry	*Prunus virginiana*	N	White	Tree	20	10-20	Medium	No	Manage as a tree or shrub based on pruning. **Poisonous to livestock.**
Rosemary	*Rosmarinus officinalis*	I	blue	Shrub	4	3-5	Low	No	Evergreen.
Thimbleberry	*Rubus parviflorus*	N*	White	Shrub	4	2-4	Low	No	Suckering will expand plant over time.
Trailing blackberry	*Rubus ursinus*	N*	White	Vine	1	NA	Low	No	Present in the landscape.
Red Elderberry	*Sambucus racemosa*	N*	Cream	Shrub	12	7-15	Medium	No	Provides pithy stems for solitary bee nests. Fair establishment from cuttings.
Highbush Blueberry	*Vaccinium corybosum*	I	White	Shrub	6	7-15	Medium	No	Attractive to bumble bees
Evergreen Huckleberry	*Vaccinium ovatum*	N*	Pink	Shrub	5-10	3-5	Medium	No	Evergreen. Important for spring build-up on the Coast. Host for spotted wing drosophila
Red Huckleberry	*Vaccinium parvifolium*	N*	Pink	Shrub	5-8	3-5	Medium	No	Present in landscape. Needs rich organic soil. May be difficult to establish.
Mid-Season Blooming Species									
Douglas hawthorn	*Craetagus douglasii*	N*	White	Tree	30	10-20	Medium	No	Generally present in adjacent riparian areas. Thorns on branches.
Salal	*Gaultheria shallon*	N*	Pink	Shrub	6	3-5	Low	No	Evergreen. Abundant nectar.
Pacific Rhododendron	*Rhododendron macrophyllum*	N*	Pink	Shrub	5-20	5-10	Low-Medium	No	Evergreen. Worked by bumble bees, not honey bees
Baldhip Rose	*Rosa gymnocarpa*	N	Pink	Shrub	3	3-5	Low	No	Does well in dry sites. Suckering will expand plant over time.
Nootka Rose	*Rosa nutkana*	N	Pink	Shrub	10	3-5	Medium	No	Suckering will expand plant over time.
Clustered/Swamp Rose	*Rosa pisocarpa*	N*	Pink	Shrub	10	3-5	Medium	No	Can do well in wet sites. Suckering will expand plant over time.
Sage	*Salvia officinalis*	I	Blue	Shrub	2	3-6	Low	No	Evergreen. Culinary herb.
Blue Elderberry	*Sambucus nigra subsp. cerulea*	N*	White	Shrub	6-20	7-15	Medium	No	Provides pithy stems for solitary bee nests. Good establishment from cuttings.
Snowberry	*Symphoricarpos albus*	N*	Pink	Shrub	4 –6	3-5	Low	No	Abundant nectar - sugars 47-58%. Suckering will expand plant over time. Fair to good establishment from cuttings (live stakes).
Mid to Late Season Blooming Species									
Western Yarrow	*Achillea millifolium* var. *occidentalis*	N	White	Herbaceous	2	2	Low	No	Evergreen. Good for beneficial insects. Long bloom period
Pearly everlasting	*Anaphalis margaritacea*	N*	White	Herbaceous	2	2	Low	Yes	Abundant in burned or cut-over areas and along roads in Coast Mtns. Nectar sugar ~34%
New England Aster	*Aster novae-angliae*	I	Pinks to purples	Herbaceous	3	3-5	Medium	Yes	Heavy blooming. Suckering will expand plant over time.

COMMON NAME	SCIENTIFIC NAME	N = native; I = Introduced	Flower Color	Growth Form	Mature Height (feet)	Planting distance Apart (feet)	Water Needs	Wind-blown Seed - or potential to invade beds	NOTES
Borage	*Borago officinalis*	I	Blue	Herbaceous	2	2-4	Medium	No	Valued nectar plant. An annual plant - may need to be reseeded. Time planting so blooms following cranberry bloom.
Summer-blooming heathers	*Calluna vulgaris*	I	White to deep pinks	Herbaceous	2	3-5	Low	No	Evergreen. Many varieties; summer blooming. Very attractive to honey bees. Generally need good drainage. Should shear/cut back after flowering to maintain good shape and bloom.
Wild Lilac	*Ceanothus intergerimus*	N	White to blue	Shrub	10	5-10	Low	No	Good nectar and pollen source where abundant
Fireweed	*Chamerion angustifolium*	N	Fuschia	Herbaceous	4	3-5	Low	Yes	Abundant in burned or cut-over areas in Coast Mtns. High nectar production. May be invasive to beds.
Echinacea	*Echinacea spp.*	I	Pinks, yellows, oranges, reds	Herbaceous	3	2-3	Medium	No	Many varieties. Attractive to bees and beneficials.
Seaside daisy	*Erigeron glaucus*	N	lavendar	Herbaceous	2	2-4	Medium	Yes	Profuse nectar production.
Ocean Spray	*Holodiscus discolor*	N*	Cream	Herbaceous	12	7-15	Medium	No	Used especially by beneficial insects
Rose of Sharon	*Hybiscus syriacus*	I	White, pinks, purples	Shrub	10	7-15	Medium	No	May select single flower varieties over double-flowered varieties to assure nectar production. Look for sterile varieties, such as 'Minerva', to minimize expansion by seedlings.
Bird's-foot trefoil	*Lotus corniculatus*	I	Yellow/orange	Herbaceous	1	NA	Low	Yes	A weedy plant known to invade cranberry beds. It has often been planted in pastures surrounding beds and is generally present in the surrounding landscape. It is attractive to and can provide valuable nectar resources to bees.
Catmint	*Nepeta cataria*	I	White	Herbaceous	3	3-5	Medium	No	Heavy nectar producer (sugars ~29%)
Oregano	*Oreganum*	I	White	Herbaceous	1	3-5	Medium	No	Culinary herb. Many varieties. Nectar abundant.
Penstemon	*Penstemon spp.*	I	Creams, pinks, reds, purples	Herbaceous	3	3-5	Medium	No	Many varieties. Attractive to bees and hummingbirds - sugars ~35%. Short-lived perennials
Bee plant/Phacelia	*Phacelia tanecifolia*	I	blue	Herbaceous	3	NA	Medium	No	Very attractive to bees. An annual plant - may need to be reseeded. Flowers about eight weeks after germination and flowers 6-8 weeks. Time planting so blooms following cranberry bloom.
Douglas Spirea	*Spirea douglasii*	N	Deep pink	Shrub	6	5-10	Medium	No	Minor source of pollen. Suckering will expand plant over time; may invade cranberry beds. Fair establishment from cuttings.
Thyme	*Thymus serphyllum*	I	White	Herbaceous	1-2	3-5	Medium	No	Culinary herb. Many varieties. Abundant nectar.

COMMON NAME	SCIENTIFIC NAME	N = native; I = Introduced	Flower Color	Growth Form	Mature Height (feet)	Planting distance Apart (feet)	Water Needs	Wind-blown Seed - or potential to invade beds	NOTES
Alsike/Hybrid clover	*Trifolium hybridum*	I	Cream to pink	Herbaceous	2	NA	Medium	No	Plant from seed. Will tolerate heavy, wet soils. Copious nectar.
Red clover	*Trifolium pratense*	I	Pink	Herbaceous	3	NA	Medium	No	Plant from seed. Should mow high (6" or greater) to maintain growing points
White clover	*Trifolium repens*	I	White	Herbaceous	1.5	NA	Medium	No	Plant from seed. Copious nectar production and fine honey production
Late Season Blooming Species									
Hyssop	*Agastache spp.*	I	Pinks to purples	Herbaceous	3	3-5	Medium	No	Many varieties. Bumble bee and hummingbird attractant
Coyote bush	*Baccharis pilularis*	N*	cream	Shrub	8	7-15	Low	Yes	Dioecious. Plant male plants to provide critical pollen source. May remove female seed (nectar) plants to reduce movement into bogs
Cosmos	*Cosmos sulphureus*	I	whites, pinks, purples	Herbaceous	6	3-4	Medium	No	Annual species - may need to reseed. Can plant from plugs.
Sunflower	*Helianthus annuus*	I	Yellow	Herbaceous	4-8	3-4	Low	No	An annual plant - will frequently reseed well. Attractive nectar - sugars ~32% and large quantity of pollen. Can plant from plugs.
Black-eyed Susan	*Rudbeckia spp.*	I	Yellows and oranges	Herbaceous	3	3-4	Low	No	
West Coast goldenrod	*Solidago elongata*	N	Yellow	Herbaceous	3	3-4	Medium	Yes	Produce great amounts of pollen. May mow before going to seed to keep from spreading into beds.
Douglas aster	*Symphyotrichum subspicatum*	N	lavendar	Herbaceous	3.5	3-5	Medium	Yes	Will spread vegetatively. May mow before going to seed to keep from spreading into beds

Table 2. Bloom timing for pollinator plants for Cranberry Beds. This information was assembled from a variety of sources, including personal knowledge of the plants, Burgett et al. 1989, Lovell 1926, Macfarlane and Patten 1997, Lintner 2014, and from various herbarium collections. Bloom timing can vary widely depending on elevation, exposure, micro-climate and year-to-year climatic variations.
*= good; **=better; ***=best; ? = unknown importance

		Bloom Color	Bees	Beneficial Insects	Nectar	Pollen	Wildlife Mast (berries, cones, seeds)	Bloom time (months)								
Common name	**Scientific name**							**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**
Trees																
Sitka willow	*Salix sitchensis*	Greenish	***	***	***	***										
Scouler's willow	*Salix scouleriana*	Greenish	***	***	***	***										
Pacific willow	*Salix lasiandra* var. *lasiandra*	Greenish	***	***	***	***										
Bigleaf maple	*Acer macrophyllum*	Yellow	***	**	**	**										
Cascara	*Frangula (Rhamnus) purshianus*	Greenish	***	**	***	**	berries					?				
Serviceberry	*Amelanchier alnifolia*	White	**	*	**	**	berries			w	w	w				
Pacific madrone	*Arbutus menziesii*	Cream	***	**	***	*	berries									
Bitter cherry	*Prunus emarginata*	White	**	**	**	**	berries			w	w					
Chokecherry	*Prunus virginiana*	White	***	**	***	**	berries			w	w					
Western crabapple	*Malus fusca*	White	**	**	**	**	apples				w					
Douglas hawthorn	*Craetagus douglasii*	White	**	**	**	**	berries				w	w				
Shrubs																
Winter Blooming Heaths	*Erica x darleyensis, Erica carnea*	White to deep pinks	**	**	**	*										
Blue blossom	*Ceanothus thyrsiflorus*	blue	***	***	***	***										
Hairy manzanita	*Arctostaphylos columbiana*	Pink	***	**	**	**	berries									
Kinnikinnick	*Arctostaphylos uva-ursi*	Pink	***	*	**	**	berries									
Red-flowering currant	*Ribes sanguineum*	Pink to red	**	**	**	**	berries									
Salmonberry	*Rubus spectabilis*	Fuchia	**	*	**	*	berries									
Tall Oregon grape	*Berberis aquifolium*	Yellow	***	**	***	***	berries									
Black twinberry	*Lonicera involucrata*	Yellow	*	*	**	*	berries									
Cascade Oregon grape	*Berberis nervosa*	Yellow	**	*	**	**	berries									
Vine maple	*Acer circinatum*	Red	**	**	***	***										
Trailing blackberry	*Rubus ursinus*	White	***	**	***	**	berries			w	w					
Highbush Blueberry	*Vaccinium corybosum*	White	***	**	***	**	berries			w	w					

		Bloom Color	Bees	Beneficial Insects	Nectar	Pollen	Wildlife Mast (berries, cones, seeds)	Bloom time (months)								
Common name	**Scientific name**							**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**
Thimbleberry	*Rubus parviflorus*	White	***	**	***	**	berries			w	w	w				
Red elderberry	*Sambucus racemosa*	Cream	*	**	*	**	berries									
Evergreen huckleberry	*Vaccinium ovatum*	Pink	***	*	***	*	berries									
Red huckleberry	*Vaccinium parvifolium*	Pink	*	*	*	*	berries									
Golden chinkapin	*Castanopsis chrysophylla*	Cream	***	**	***	***	nuts									
Salal	*Gaultheria shallon*	Pink	*	*	**	?	berries									
Cranberry	*Vaccinium macrocarpon*	Pink	***	?	***	**										
Pacific rhododendron	*Rhododendron macrophyllum*	Pink	?	?	?	?										
Baldhip rose	*Rosa gymnocarpa*	Pink	**	**	**	**	hips									
Nutka rose	*Rosa nutkana*	Pink	**	**	**	**	hips									
Clustered wild rose	*Rosa pisocarpa*	Pink	**	**	**	**	hips									
Blue elderberry	*Sambucus nigra ssp. cerulea*	Cream	*	**	*	***	berries									
Snowberry	*Symphoricarpos albus*	White to pink	***	***	***	**	berries									
Oceanspray	*Holodiscus discolor*	Cream	**	***	**	**										
Douglas spiraea	*Spiraea douglasii*	Pink	**	**	**	**										
Rose of Sharon	*Hybiscus syriacus*	White, Pinks, purples	**	**	**	**										
deerbrush	*Ceanothus integerrimus*	white-blue	***	***	***	***										
Summer Blooming Heather and heaths	*Calluna vulgaris; Erica carnea (summer varieties)*	White to deep pinks	**	**	**	?										
Coyote bush	*Baccharis pilularis*	White	**	**	?	**	seed							w	w	
Herbaceous Plants																
Rock cress	*Arabis spp.*	White	**	**	**	?			w	w	w					
Aubretia	*Aubretia spp.*	Purples	**	**	**	?										
Wallflower	*Erysimum spp.*	yellows to oranges	***	**	**	**										
California poppy	*Eschscholzia californica*	yellows to oranges	***	**	**	***										
Alsike/Hybrid clover	*Trifolium hybridum*	cream to pink	***	***	***	**										
White/Dutch clover	*Trifolium repens*	white	***	***	***	**						w	w	w		
Red clover	*Trifolium pratense*	medium pink	***	***	***	**										
Seaside daisy	*Erigeron glaucus*	lavendar	***	***	***	**										

		Bloom Color	Bees	Beneficial Insects	Nectar	Pollen	Wildlife Mast (berries, cones, seeds)	Bloom time (months)								
Common name	**Scientific name**							**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**
Fireweed	*Chamerion angustifolium*	Fuschia	***	***	***	**										
Echinacea	*Echinacea spp*	pinks, yellows, oranges, reds	***	***	***	**										
Western yarrow	*Achillea millifolium* var. *occidentalis*	White	*	***	*	*							w	w		
Pearly everlasting	*Anaphalis margaritacea*	White	**	**	**	*							w	w		
Thyme	*Thymus serphyllum*	White	***	***	***	**							w	w	w	
Catmint	*Nepeta cataria*	White & lavendar	***	**	***	**	seed						w	w	w	
Oregano	*Oreganum sp.*	White	***	***	***	**							w	w	w	
Borage	*Borago officinalis*	blue	***	**	***	**										
bee plant/Phacelia	*Phacelia tanecifolia*	blue	***	***	***	**										
Penstemon	*Penstemon spp.*	Pinks, reds, purples	**		**	**										
New England Aster	*Aster novae-angliae*	Pinks to purples	***	***	***	***	seeds									
Hyssop	*Agastache spp.*	Pinks to purples	***	**	***	**										
Cosmos	*Cosmos sulphureus*	whites, pinks, purples	**	**	**	**										
Black-eyed Susan	*Rudbeckia spp.*	yellows to oranges	***	***	***	*										
Bird's-foot trefoil	*Lotus corniculatus*	Yellow-orange	**	*	**	?										
Sunflower	*Helianthus annuus*	Yellow	***	***	***	***	seeds									
Western goldenrod	*Solidago lepida var. salesbrosia*	Yellow	***	***	***	**	seeds									
Douglas aster	*Symphyotrichum subspicatum*	lavendar	***	***	***	**	seeds									